opinion they are due to a *loss of all the after-birth-acquired sensations.* The animal loses the power of associating the impressions received with any which had previously been made; or, as it can be more understandingly, though, perhaps, less accurately, expressed, the animal in whom the hemispheres have been removed has lost the power of memorizing.

A dog who very readily gave me his paw, or sat on his haunches, on giving him certain signs, did not even attempt to do so after its hemispheres had been removed. All attempts to learn him his old tricks proved futile.

When a needle was run through the paw of a dog thus mutilated, he gave evidences of feeling pain by running his nose towards the irritated point, which, however, he was unable to find. He had evidently lost all his acquired ideas of a sense of location.

A normal dog will, when placed in a room, seek a sleeping place, to which he always will return, but a dog in whom the hemispheres have been removed is just as likely each time to take a new bed place.

These animals still evidence thankfulness to the person feeding them, but possess no recollection of this person ten minutes later.

Not a muscle of the body of an animal in whom the hemispheres had been removed was paralyzed.

General sensibility appeared to be uninvolved, though at times there appeared to be a state of hyperæsthesia. The senses of touch, of pressure, and of differences in temperature, were no longer possessed by these animals.

Article VI.

The Anatomy of the Brachial Plexus. By J. F. Walsh, M.D., of Philadelphia.[1]

Four years ago, at the suggestion of my preceptor, Dr. Wm. W. Keen, I commenced the investigation of this subject with the intention to dissect as many plexuses as possible, and to determine from these which of the numerous arrangements described in the anatomical works was most common in the subject, and therefore the normal one. To my surprise, after having made a number of dissections, I found that they did not correspond to any of the descriptions of the books, the nearest approach being to the disposition given in Sappey's work. Being confident, from the care taken, that my results were correct, I was led to the conclusion that the variations of the authors were not true ones. That this impression was not erroneous, I subsequently proved in the manner described in the following pages.

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[1] Extracted from a Thesis presented to the Faculty of the Medical Department of the University of Pennsylvania for the degree of Doctor of Medicine, and awarded one of the prizes, March, 1876. The remainder of the Thesis on the Comparative Anatomy of the Plexus, together with the anomalies found in the human subject, the author expects to present to the Academy of Natural Sciences of Philadelphia.

In my dissections I did not always obtain both sides of the subject, hence, quite often, one subject furnished me only one plexus. It is for this reason that I have enumerated the number of plexuses, instead of subjects. Many dissections made by others, in my absence, I have omitted, considering only those made by myself or in my presence, making in all three hundred and fifty plexuses.

The arrangement of the nerves constituting the brachial plexus is one of the few subjects in gross anatomy, I believe, on which anatomists differ much. Among the numerous and varied descriptions to be found there is no single one which may be said to be more generally accepted than the others, so that it is impossible to determine from the books what is the most constant or normal arrangement. What one author will describe as the usual disposition another will state to be an anomaly, and so on to the great confusion of the reader, who finally will, very likely, be led to the conclusion that this plexus has no special arrangement, but that it is an irregular intertexture of nerve filaments constructed upon no definite plan. Some anatomists, in fact, directly state this—Maclise,[1] for instance, says, "The axillary plexus well merits its name, for I have not found it in any two bodies assuming a similar order or arrangement."

The following examples will give an idea of what a variety of descriptions exists. Gray[2] states that—

> "The fifth and sixth cervicals unite near their exit from the spine into a common trunk; the seventh cervical joins this trunk near the outer border of the middle scalenus; and the three nerves thus form one large single cord. The eighth cervical and first dorsal nerves unite behind the anterior scalenus into a common trunk. Thus two large trunks are formed, the upper one by the union of the fifth, sixth, and seventh cervicals; and the lower one by the eighth cervical and first dorsal. Opposite the clavicle, and sometimes in the axilla, each of the cords gives off a fasciculus, by the union of which a third trunk is formed."

Heath,[3] Leidy,[4] Quain,[5] Ellis,[6] and Flower[7] give the same arrangement. The arrangement furnished alike by Sappey,[8] Cruveilhier,[9] Hirschfeld,[10] Henle,[11] Hyrtl,[12] Longet,[13] and Lucas[14] differs mainly from the preceding in that the seventh does not join the common cord of the fifth and sixth, but runs as a separate trunk, dividing below as do the other trunks.

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[1] Surgical Anatomy, 1861, p. 29.

[2] Anatomy, Descriptive and Surgical, 1871, p. 638.

[3] Practical Anat., 1st Amer. from 2d Eng. ed., edited by Keen, 1870, p. 31.

[4] An Elementary Treatise on Human Anat., 1861, p. 563.

[5] Human Anat., 7th ed., p. 81.

[6] Demonstrations of Anat., 7th ed., p. 81.

[7] Diagrams of the Nerves of the Human Body, edited by Keen, 1872, pl. iii.

[8] Traité d'Anat. Descrip., 2de ed., tome iii. 1872, p. 406.

[9] Traité d'Anat. Descrip., 4me ed., tome iii. 1871, p. 599.

[10] Traité et Iconograph. du Syst. Nerv., 1866, p. 147.

[11] Handbuch der Systematisch. Anat. des Mens., Drit. band, zweite abth., 1871, p. 473.

[12] Handbuch der Anat., 8er ed., 1863, pp. 838–9.

[13] Anat. et Physiol. du Syst. Nerv. de l'Homme et des Animaux vertb., 1842, tome i. pp. 844–5.

[14] The Normal Arrangement of the Brachial Plexus, Guy's Hosp. Rep., vol. xx. 3d Series, 1875, p. 539.

Holden,[1] Paulet,[2] and Wilson[3] say that there are only two cords in the axilla, one formed by the fifth, sixth, and a portion of the seventh, the other by the remainder of the seventh, the eighth, and first dorsal; while Malgaigne,[4] Langer,[5] Aeby,[6] Létiévant,[7] Cloquet,[8] and Mangeti[9] describe only one large bundle into which the five primary trunks run.

Harrison,[10] Wilson,[11] Morton,[12] Luschka,[13] Führer,[14] Valentine,[15] Velpeau,[16] Sarlandiere,[17] Wistar,[18] Bryant,[19] Tuson,[20] Paxton[21] Hooper,[22] Fyfe,[23] Cuvier,[24] Bell,[25] Bayle,[26] Douglas,[27] Edwards,[28] Monro,[29] Cheselden,[30] and Scarpa[31] simply describe the plexus as an interlacement of nerve fibres, evidently considering that there is no definite plan in its arrangement.

There are some descriptions which, as far as I can ascertain, are peculiar to single authors. Among these may be mentioned those of Heitzman,[32]

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[1] Manual of Anat., 3d ed., p. 208.

[2] Traité d'Anat. Topograph., 1870, pp. 297–8.

[3] The Anatomist's Vade Mecum, 9th ed., p. 513.

[4] Traité d'Anat. Chirurg., 1859, tome ii. p. 152.

[5] Topografisch. Anat., 1859, p. 498.

[6] Lehrbuch der Anat., 1871, p. 884.

[7] Traité des Sections Nerveuses, 1873, p. 468.

[8] A System of Anat., trans. from the French by Robert Knox, 4th ed., 1830, p. 487.

[9] Theatrum Anatom., tom. prim., 1723, pp. 181–2.

[10] The Dublin Dissector, 3d Amer. from 5th Dub. ed., p. 336.

[11] Human Anat., 4th Amer. from last London ed., 1856, p. 414.

[12] Illust. System of Anat., 1849, pp. 512–13.

[13] Anat. des Mens., Band iii., abth. i. 1865, p. 236.

[14] Handbuch der Chirurg. Anat., Erste abth., 1857, p. 398.

[15] Traité de Néuralog., traduit de l'Allemand par A. J. Jourdan, Encycloped. Anat., tome v. 1843, pp. 503–4.

[16] Manuel d'Anat. Chirurg., 1838, pp. 200–1.

[17] Traité du Syst. Nerv., 1840, p. 156.

[18] A Syst. of Anat., 1817, vol. ii. p. 352.

[19] Examinations in Anat. and Physiol., 1835, p. 383.

[20] The Dissector's Guide, 2d ed., 1837, p. 109.

[21] An Introduction to the Study of Human Anat., 1834, vol. ii. p. 105.

[22] The Anatomist's Vade Mecum, 7th ed., 1805, p. 176.

[23] A Compendium of the Anat. of the Human Body, 1802, vol. ii. p. 247.

[24] Lectures on Comp. Anat., trans. from the French by Wm. Ross, 1802, vol. ii. p. 250.

[25] The Anat. of the Human Body, 1809, vol. ii. pp. 120–1.

[26] Traité élément. d'Anat., Quatrième ed., 1833, p. 356.

[27] An Anatom. Exposition of the Structure of the Human Body, 5th ed., 1776, pp. 79–80.

[28] Manual of Surg. Anat., 1st Amer. from 1st Lond. ed., trans. by Wm. Coulson, 1828, p. 109.

[29] A Syst. of Anat. and Physiol., 1801, vol. ii. pp. 21–25.

[30] Anat. of the Human Body, 9th ed., 1768, p. 242.

[31] Annatom. Annotat. de Nerv. Gangliis et Plexibus, Lib. prim., 1753, pp. 70–2.

[32] Descrip. und Topograf. Anat., Nerven Syst., 1871, p. 141.

Rudinger,[1] Froriep,[2] Pirogoff,[3] Krause,[4] Meckel,[5] Craigie,[6] Vesalius,[7] and Swan.[8] The arrangement that Heitzman gives is as follows: The fifth and sixth unite to form a single trunk; the eighth and first dorsal form another, which almost immediately splits into two portions of unequal size, a superior, quite small, and an inferior almost as large as the main trunk; the seventh runs downward for a short distance as a single trunk, but finally also divides, the superior branch being inconsiderable, the inferior large. These five cords then unite in the following manner; the superior division of the seventh joins the common trunk of the fifth and sixth, while the inferior unites with the superior branch of the eighth and first dorsal, leaving three cords. Finally, the two upper of these fuse together, so that opposite the clavicle there are two large trunks. In the axilla each one gives off from its internal aspect a branch so as to form a third cord.

Now, if all these arrangements really exist the plexus is variable indeed; but what I propose to show is that they do not exist, and that most of them can be artificially produced. There is only one arrangement, which the nerves follow without much deviation; it is shown in Fig. 1: the fifth cervical, after receiving a small filament from the fourth near its exit from the intervertebral foramen, unites with the sixth at the outer border of the Scalenus Anticus. Most anatomists, if not all, describe these two nerves as fusing together to form a large single trunk; but such is not the case. The manner in which the filaments of the two commingle is this: the fifth, just as it comes in contact with the sixth, gives off from its inner side a small bundle of filaments, which runs downward and across the latter nerve to receive a supply from its inner aspect, thus forming a cord of quite considerable size; the remaining fibres of the two nerves unite somewhat higher up, making another cord larger than the preceding one, which is at first placed externally and posteriorly, but finally internally to it.

The eighth cervical and first dorsal unite beneath the scalenus anticus into a common trunk, which a little lower down gives off from its upper side a small branch to the musculo-spiral nerve.

The seventh cervical runs separate, splitting about an inch and a half above the clavicle into two portions. The superior, somewhat the larger of the two, unites with the anterior branch of the fifth and sixth to form the outer cord; the inferior with the posterior of the same to form a trunk common to the circumflex and the larger root of the musculo-spiral.

The outer cord is formed opposite the lower border of the clavicle.

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[1] Anatomie des Mens., Ruckenmarks-nerven, 1870, Taf. ix.

[2] Atlas Anatomicus, 5er ed., Taf. ix.

[3] Topograf. Anat., Tafs. 17, 18.

[4] Beiträge zur Nerv. der Oberen Extrem., 1865, Taf. iii.

[5] Manual of Gen. and Descrip. Anat., trans. by A. Sidney Roane, 1832, pp. 21–26.

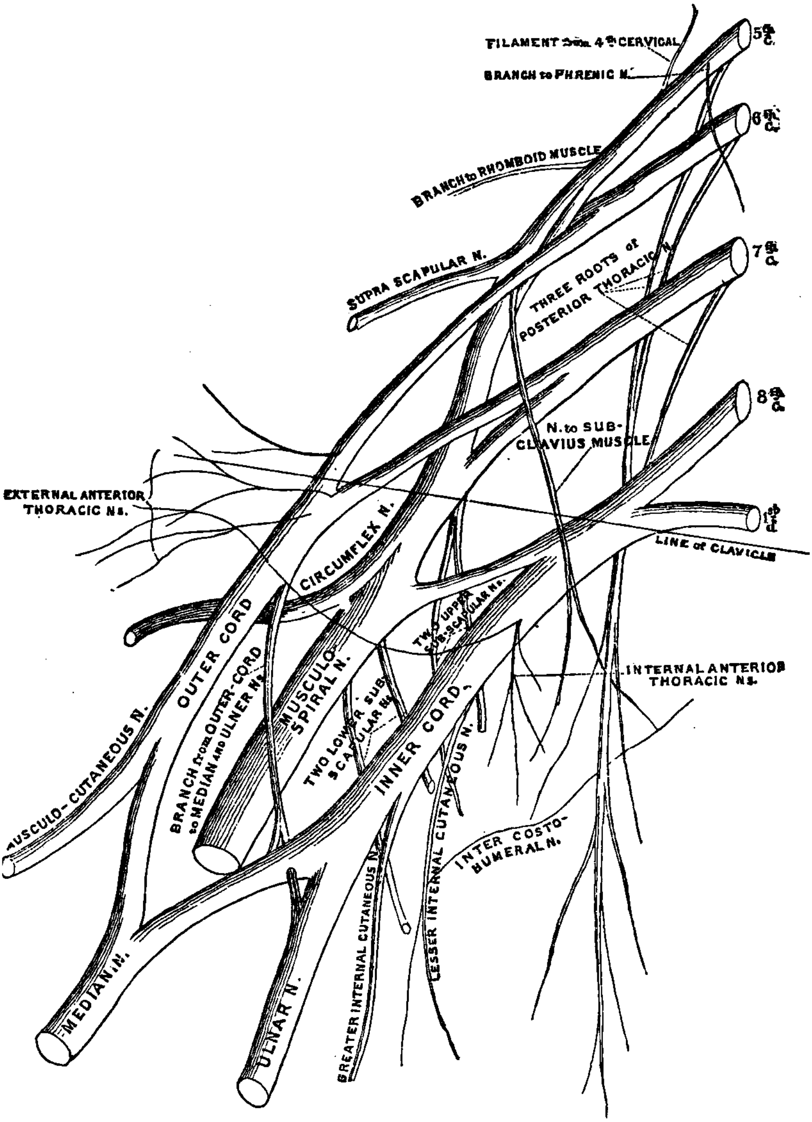
[6] Elements of Gen. and Path. Anat., 1828, p. 374.

[7] De Human. Corp. Fabrica, 1543, p. 344.

[8] Demonstration of the Nerves of the Human Body, 1832, p. 2, iii.

Midway between this bone and the coracoid process, it gives off from its internal aspect a small branch, which, running obliquely across the axilla, in front of the axillary artery, joins the inner cord just at the point where it divides into the internal head of the median and the ulnar. Here its component filaments separate into two bundles of about equal size, one of which supplies the internal head of the median, while

Fig. 1.


FILAMENT from 4th CERVICAL
BRANCH to PHRENIC N.
5th C.
6th C.
BRANCH to RHOMBOID MUSCLE
SUPRA SCAPULAR N.
7th C.
THREE ROOTS of POSTERIOR THORACIC N.
8th C.
N. to SUB-CLAVIUS MUSCLE
EXTERNAL ANTERIOR THORACIC Ns.
1st D.
LINE of CLAVICLE
CIRCUMFLEX N.
OUTER CORD
BRANCH from OUTER-CORD to MEDIAN AND ULNER Ns.
MUSCULO-SPIRAL N.
TWO UPPER SUB-SCAPULAR Ns.
INTERNAL ANTERIOR THORACIC Ns.
MUSCULO-CUTANEOUS N.
TWO LOWER SUB-SCAPULAR Ns.
INNER CORD
LESSER INTERNAL CUTANEOUS N.
INTER COSTO-HUMERAL N.
GREATER INTERNAL CUTANEOUS N.
MEDIAN N.
ULNAR N.

the other pierces the latter and joins the ulnar. I have found only three anatomists who refer to it. Leidy,[1] in his description of the ulnar nerve, says that it is derived from the lower and outer trunks (that is, the internal and external cords), thereby inferring that such a branch exists. Henle[2] says that sometimes the ulnar nerve has a partial origin from the outer cord; and Turner[3] describes it as an anomaly. It is shown in the diagrams of the plexus in the works of Cruveilhier,[4] Hirschfeld,[5] Sappey,[6] Swan,[7] and Paulet;[8] but these authors say nothing about it in their descriptions of the nerves. But though so rarely met with in anatomical works, it is by no means as infrequent an occurrence in the subject; indeed, its presence is almost constant. I did not notice it in the first sixty plexuses examined, but after once observing it, I always carefully searched for it, and in the remaining two hundred and ninety plexuses I found that it was absent in only twenty-five. In thirteen of these, moreover, this branch (whose filaments are, as a rule, derived entirely from the seventh cervical) was replaced by a small branch which arose directly from the superior division of the seventh, above the clavicle, and, running beneath that bone in front of the lower portion of the subclavian artery, joined the inner cord quite high up in the axilla. On tracing the distribution of its filaments it was found that they were distributed to the internal head of the median and the ulnar. In the cases in which it was present it was not always of the same size. Usually it was intermediate in bulk between the two internal cutaneous nerves, this obtaining in one hundred and fifty of the plexuses; in seventy-six it was smaller, being about equal, in most, to the lesser internal cutaneous; in a few, reduced to a mere filament; and in thirty it was much bigger, being somewhat larger than the greater internal cutaneous.[9] It did not always arise from the same point of the outer cord; in one hundred and fifty-six plexuses it came off a short distance above the middle of the cord; and in the rest at different points lower down; in thirty arising from the outer head of the median itself, but having, nevertheless, the same distribution as the others, namely, to the inner head of the median and the ulnar. The ulnar nerve in ten cases did not receive any supply from this branch, all its filaments running into the internal head of the median.

The division of the outer cord into musculo-cutaneous and external head of median takes place at a short distance below the level of the coracoid process.

The inner cord is formed opposite the lower border of the clavicle. It is a little longer than the outer, dividing somewhat lower down. At about its middle it gives off the lesser internal cutaneous, and an inch below, the greater.

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[1] Op. cit., p. 568.
[2] Op. cit., p. 501.
[3] Journal of Anat. and Physiol., vol. vi. 1872, p. 103.
[4] Op. cit., p. 602.
[5] Op. cit., p. 56.
[6] Op. cit., p. 407.
[7] Op. cit., p. 26.
[8] Op. cit., Atlas.
[9] In the plexus from which the diagram was copied the branch was larger than normal.

There is no true posterior cord, such as, for instance, Gray, Quain, Sappey, Cruveilhier, Henle, and Hyrtl describe it; namely, as a large trunk formed in the upper portion of the axilla, running through this region and dividing into the musculo-spiral and circumflex nerves. These two latter arise high up, and proceed through the above space as separate cords, though bound together in a common envelope of fascia so as apparently to form but one trunk; the point at which they diverge from each other appearing to be the place at which this splits. The circumflex springs from the outer side of the trunk formed by the posterior division of the fifth and sixth, and the lower one of the seventh, the remaining portion of the latter, with the small branch of the eighth cervical and first dorsal forming the musculo-spiral.

Concerning the branches of the plexus the descriptions of authors do not vary much, hence I will only mention those about which there is some doubt.

The supra-scapular nerve came off from the posterior division of the fifth and sixth; in most cases being composed entirely of filaments from the fifth.

The posterior thoracic has three roots. Most anatomists mention only two; among these are Cruveilhier, Sappey, Wilson and Buchanan, Flower, Holden, Maclise, Rüdinger, Aeby, Ellis, Morton, Quain, Wilson, Velpeau, Richardson, Leidy, Sarlandière, and Paxton. Gray, Luschka, Heath, Richet, and Meckel say that it usually has two, but sometimes three; while Hirschfeld, Hyrtl, Henle, Lucas, Heitzman, Malgaigne, and Valentin describe these as the normal arrangement.

The subscapulars are apt to vary as to their number. There are four as often as three, and sometimes five. When four exist, the fourth is furnished by the upper subscapular; this being split up into two nerves having a common origin, as shown in Fig. 1. When five are present, the second as well as the first is divided. The upper subscapular, or the two upper when there are four, arise from the posterior division of the fifth and sixth cervicals. The middle arises from the trunk common to the circumflex and musculo-spiral, while the lower springs from the musculo-spiral.

The above I may safely assert to be the normal arrangement. Of the three hundred and fifty plexuses that I examined, in only two was there an entire alteration of the plan; while in seventy-one others, or nearly twenty per cent., there were variations in single branches, which, however, did not affect much the general mode of construction. Thus in nine cases the outer cord did not divide at the usual place, but ran immediately into the median nerve, from which, lower down, the musculo-cutaneous arose; in twelve, a short distance below the coracoid process, the outer cord split into a very small outer portion, and a large inner which joined the branch from the internal cord to form a median of unusually large size; this, at about the junction of the upper and middle thirds of the humerus, furnishing the cutaneous portion of the musculo-cutaneous, the muscular part of it constituting the small branch just mentioned; in three the branch from the trunk of the eighth cervical and first dorsal to the musculo-spiral was divided, one division coming off at the usual place, the other lower down from the internal cord; in thirteen the seventh cervical, instead of the outer cord, furnished the small branch supplying the internal head of the median and the ulnar; in thirteen the median arose by three heads, two external and one internal, the upper external springing from the outer cord a short distance above the coracoid process, the other coming off at the usual level; in eight there was no branch from the outer to the inner cord; in nine, besides the branch from the outer, there was another from the inner to the outer, the two branches crossing each other so as to form an X over the axillary artery; and in four the branch from the inner alone existed.

It is an easy matter to manufacture a variation by leaving pieces of fascia adherent to the nerves here and there throughout the plexus. In this manner I have produced many of the arrangements previously quoted, and a number of others besides. In order to understand how this can be done, I will first give a description of the fascia binding together the nerves of the plexus. The two divisions of the fifth and sixth are held together in a common envelope so as apparently to constitute but a single trunk, this continuing down to the axilla; the two branches of the seventh in like manner are united, and also the two of the common trunk of the eighth cervical and first dorsal. Apparently, and practically, then there are three cords in the neck, two at different distances above the subclavian artery, running obliquely downward toward the small upper opening of the axilla, and another behind the vessel, proceeding horizontally in the same direction. The three thus converge toward each other, and come together opposite the clavicle. Here they seem to fuse into one huge bundle, placed to the upper and outer surface of the axillary artery (the vessel making a slight bend downward, leaving the nerves above), the appearance being caused by their being enveloped together in a single sheath. This arrangement continues to a short distance above the point where the artery enters the plexus. Within the common envelope the unions and divisions previously described take place, which result in the four cords mentioned above, viz., inner, outer, and two posterior (musculo-spiral and circumflex). Processes of fascia also run in among the nerves, forming secondary bundles; thus, opposite the upper border of the clavicle the large single trunk can be resolved into two lesser ones, one made up of the two divisions of the fifth and sixth and the two of the seventh, and the other of the two branches of the eighth cervical and first dorsal, while lower down there are three, the third being formed by two roots coming from each of the preceding bundles. The outer of the three constitutes the outer cord proper, the inner the inner cord proper; while the posterior is formed of two smaller cords of unequal size, the larger being the musculo-spiral nerve, and the smaller the circumflex. As the axillary artery enters the plexus it divides the original single bundle into two, one placed to its outer and upper side, the other to its posterior and inner aspect. The former constitutes the outer cord. The latter is made up of the inner cord, and the musculo-spiral and circumflex bound together into one, so that it can be further resolved into three. A short distance below this the terminal branches of the plexus come off; the musculo-cutaneous and outer head of median spring from the outer bundle, while the inner head of median, the ulnar, the internal cutaneous, the musculo-spiral, and the circumflex, apparently have a common origin from the posterior and inner one.

Fig. 2.

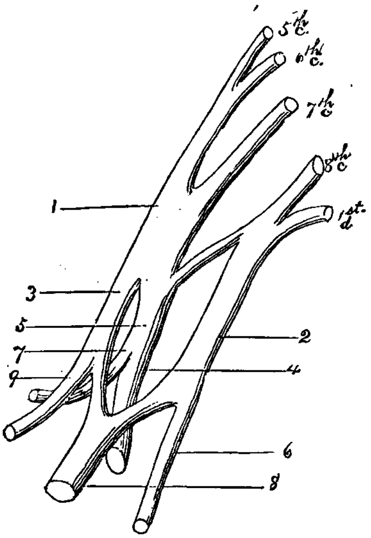

Fig. 3.

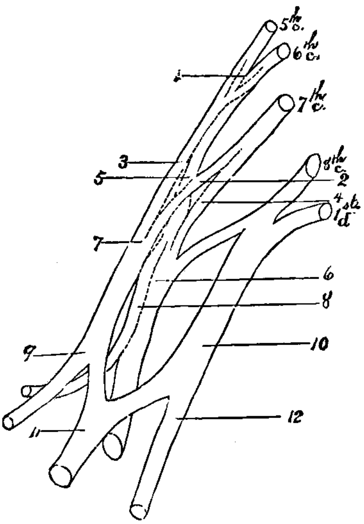

Fig. 2. Showing an arrangement produced by leaving undisturbed the enveloping fascia in the upper portion of the plexus. The smaller branches have been left out to avoid confusion. 1. Apparently a common trunk formed by the fifth, sixth, and seventh cervicals and a branch from the eighth cervical and first dorsal; 2. Inner cord; 3. Outer cord; 4. Musculo-spiral nerve; 5. Apparently a trunk common to circumflex and musculo-spiral nerves; 6. Ulnar nerve; 7. Circumflex nerve; 8. Median nerve; 9. Musculo-cutaneous nerve.

Fig. 3. Same plexus showing the arrangement of the nerves within the envelope of fascia. 1. Union of 5th and 6th cervicals; 2. Superior division of seventh cervical; 3 Anterior division of fifth and sixth cervicals; 4. Inferior division of the same; 5. Posterior division of the same; 6. musculo-spiral nerve; 7. Outer cord; 8. Circumflex nerve; 9. Musculo-cutaneous nerve; 10. Inner cord; 11. Median nerve; 12. Ulnar nerve.

In Fig. 2, the fascia has been entirely cleared away from the lower or inner portion of the plexus, while it has been allowed to remain in the upper. In this way an arrangement has been produced entirely different from the normal one. The fifth and sixth form a large single trunk, which unites below with the seventh. The cord thus formed receives a small addition from the eighth cervical and first dorsal, and then divides into two portions, the outer being the true outer cord, the inner the musculo-spiral and circumflex joined together. Within the enveloping fascia, however, as shown by the dotted lines in the lower figure, Fig. 3, the various divisions and unions took place which are found in the normal plexus. This was proved by subsequently dissecting off the adherent tissue; indeed, by simply stretching the parts the nerves could be seen dividing beneath it.

Fig. 4.

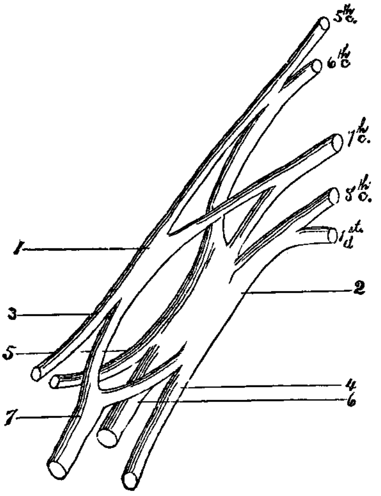

Fig. 5.

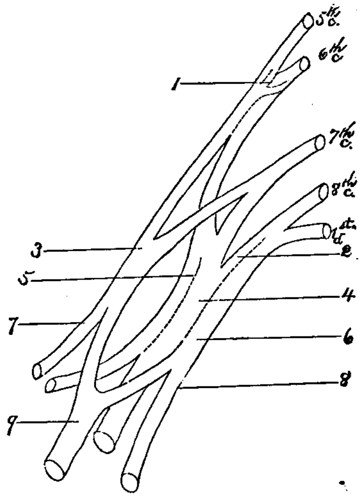

Fig. 4. Another arrangement produced by leaving undisturbed the fascia in the lower portion of the plexus. 1. Outer cord; 2. Apparently a huge trunk formed by the posterior division of the fifth and sixth cervical, the inferior of the seventh, and of the eighth and first dorsal, from which arise in common the ulnar, internal head of the median, the musculo-spiral, and the circumflex; 3. Musculo-cutaneous nerve; 4. Ulnar nerve; 5. Circumflex nerve; 6. Musculo-spiral nerve; 7. Median nerve.

Fig. 5. Same plexus showing the arrangement of the nerves within the envelope of fascia. 1. Union of fifth and sixth cervicals; 2. Branch from trunk of eighth cervical and first dorsal to musculo-spiral; 3. Outer cord; 4. Musculo-spiral nerve; 5. Circumflex nerve; 6. Inner cord; 7 Musculo-cutaneous nerve; 8. Ulnar nerve; 9. Median nerve.

In Fig. 4 the fascia in the lower portion of the plexus is not dissected off, and also a small portion covering the fifth and sixth at the point where they branch. Here we have two cords in the axilla; a smaller outer one, and a very large internal one. The latter is composed of the inferior divisions of the fifth, and sixth, and seventh cervicals, and the common trunk of the eighth cervical and first dorsal, and gives off in the lower portion of the axilla, the circumflex, musculo-spiral, internal head of median, the ulnar and internal cutaneous nerves. The outer cord is formed of the two superior branches of the fifth, and sixth, and seventh cervicals. On subsequent dissection the plexus was reduced to the normal arrangement as in the previous case.

I could give numbers of other forms produced in the same manner had I the space; but these two examples will be sufficient to demonstrate my point. In this way, also, I have made the arrangements to be found in the works of Gray, Heitzman, Froriep, Rüdinger, Pirogoff, Malgaigne, Sappey, and Holden, in part. To produce Heitzman's, however, I had to take a plexus in which the common trunk of the eighth cervical and first dorsal presented the anomaly previously described—namely, giving off two branches instead of one to the musculo-spiral; the author evidently having hit upon an anomalous plexus for his description. The arrangement of Sappey corresponds very nearly to the one I have given, differing only with regard to the union of the fifth and sixth and to the posterior cord. We have seen that the appearance of a posterior cord is produced by the musculo-spiral and circumflex nerves being held together after their origin in a common envelope of fascia. This author also does not mention the small branch proceeding from the outer to the inner cord. But this must, of course, be due to its having been destroyed in the dissection. Holden's arrangement will be seen to be very like the one in diagram 3. He, however, says that the outer cord is formed by the fifth, sixth, and a portion of the seventh, and the inner of the remaining fibres of the seventh, of the eighth, and of the first dorsal. This disposition I have never found even as an anomaly, and as it could not be made in the manner under consideration I cannot account for it in any way.

Some anatomists have gone too far, instead of not far enough, in their dissections; that is, have divided up the nerves too much. In this way no doubt the arrangements of Krause, Morton, Meckel, Vesalius, Swan, and all those anatomists who simply describe an interlacement of nerves, have been constituted, for I have produced them myself in the same manner. Hirschfeld, in his diagram, represents the fifth and sixth cervicals as each dividing high up, the four divisions subsequently uniting below. This has been caused by forcibly splitting up the nerves above the point where their filaments naturally arrange themselves into two portions. The disposition given by Craigie I cannot account for. I have never found it even as an anomaly.

There are two rules to be followed in the dissection of the nerves. One is that the point at which two or more nerves unite is not where they come together but where their filaments commingle. The other that the point of division of a nerve trunk is not where the branches separate from each other, but where the component filaments of the trunk arrange themselves into the several branches. In nearly every case when two or more nerves unite, before their fibrilles intermingle, they are held together for some distance as separate cords within a common envelope of fascia. In the same way when one divides the real point of division is some distance above the apparent one; that is, where the branches diverge from each other.

Dissected in this way nearly every plexus will be found to resolve itself into one and the same arrangement, and it will also be discovered that most of the numberless variations to be found in anatomical works are nothing but normal arrangements distorted by wrong dissections.

As there seems to be some difference of opinion with regard to the distribution of the filaments composing the five primary trunks to the terminal branches of the plexus I will give my results in seventy-four plexuses. Previous to dissecting each one I immersed it for two days in dilute nitric acid[1] (one part of the fuming acid to four of water). By this means the connective tissue (areolar tissue) surrounding the nerves was gelatinized so that the component filaments of each nerve could be distinctly seen through it, in this way making the dissection much clearer than without preparation; indeed, in the latter case it was impossible to determine accurately the distribution. After this I pinned it on a shallow black basin filled with water in such a way as to put each nerve on the stretch, and then dissected it beneath the water. The latter floated up any shreds of connective tissue not affected by the acid, thus preventing them from rolling up and imitating, as they often do so closely, true nerve fibres, while the dark background of the basin rendered each white fibrile clear and distinct.

The musculo-cutaneous was supplied by the fifth and sixth in fifty cases, in twenty-three by these and the seventh, and in one (an anomalous plexus) by a few filaments from the fourth, and by the fifth and sixth. The median in sixty-six by all five, in eight by the four lower. The ulnar in seventy-one by the seventh, eighth, and first dorsal, in two by the two latter, and in one (same anomaly as above) almost entirely by the seventh, a few fibres being furnished by the eighth. The greater internal cutaneous in fifty-three by the eighth and first dorsal, in twenty by the first dorsal, and in one (same anomaly) by the seventh alone. The lesser internal cutaneous in sixty-two by the first dorsal, in eleven by the eighth and first, and in one (same anomaly) by the seventh alone.[2] The circumflex in sixty-three by the fifth and sixth, in ten by the fifth, sixth, and seventh, and in one (same anomaly) by the seventh and eighth. The musculo-spiral in sixty-seven by the fifth, sixth, seventh, and eighth, in six by all five, and in one (same anomaly) by the sixth and seventh.

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[1] I tried other substances such as sulphuric, muriatic, and acetic acids, caustic soda and potash, salt, and lime-water, but none acted as well as nitric acid. If made stronger than the above it would destroy the neurilemma and pulpify the nerve substance, rendering dissection impossible. I also tried boiling the nerves, but this macerated them so much that they fell apart in small shreds.

[2] This nerve, also, receives further down the intercosto-humeral nerve made up of filaments from the second dorsal nerve.

I will also add that the sensory and motor fibres of each trunk are thoroughly mixed by the time that they emerge from the intervertebral foramina, so as not to be distinguishable from each other. The two roots (sensory and motor), on coming together a short distance from the intervertebral foramen, immediately commingle their filaments.

It will be seen from the description of the nerves previously given, that in case it becomes necessary to destroy the distributions of the nerves of the inner side of the arm, the small branch from the outer cord to the ulnar and the internal head of the median will have to be cut as well as the inner cord. It should also be remembered in operations upon the plexus that the small branch from the fourth cervical does not run into the plexus proper, but is simply confined to the branch to the rhomboid muscle, and that the intercosto-humeral joins the lesser internal cutaneous in the lower third of the axilla.

I desire to take the opportunity here of expressing my sincere thanks to Drs. W. W. Keen and H. C. Chapman for the kind interest which they chose to take in my work, and for the many facilities for dissection and observation afforded me by them.

ARTICLE VII.

FALLACIES OF REINSCH'S TEST FOR ARSENIC.

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IN the application of Reinsch's test for the detection of arsenic, as is well known, the physical appearance of the deposit will rarely enable the observer to state, with any degree of certainty, its true nature, since there are other metals that will deposit upon the copper under like conditions, and may present a very similar appearance. Hence, to determine the true nature of the deposit it is necessary to subject it to a further or confirmatory test, which usually consists in heating the coated copper in a reduction-tube, and observing the character of the sublimate, if any, produced, which in the case of arsenic consists of octahedral crystal, even if only an almost infinitesimal quantity of that metal be present.

The production of these crystals has generally been considered conclusive evidence of the presence of arsenic, since the only other metals that will yield sublimates are mercury, in which the sublimate is in the form of minute globules, and antimony, which, as usually stated, will yield an amorphous sublimate.